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McSwiggen

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[54] **POTENTIOMETER DETENT**

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[73] Assignee: **Knowles Electronics, Inc.**, Itasca, Ill.

[21] Appl. No.: **09/324,438**

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[51] **Int. Cl.**[7] **H01C 10/32**

[52] **U.S. Cl.** ..... **338/167**; 338/190; 338/162; 200/11 K; 200/11 G

[58] **Field of Search** ..... 338/73, 68, 118, 338/135, 160, 162, 163, 167, 190; 200/11 G, 11 K, 180

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Assistant Examiner—Karl Easthom
Attorney, Agent, or Firm—Wallenstein & Wagner, Ltd.

[57] **ABSTRACT**

A potentiometer is disclosed that provides a user with tactile feel while making adjustments. The potentiometer includes a housing having a central bore with a rotor extending therein. A knob having a protrusion is operably connected to the rotor along with a wiper. A detent member having a lobe attachment segment and a fixed segment is operably connected to the housing. The lobe is deflected by the knob protrusion while the ring is compressed by forcing the lobe attachment segment towards said fixed segment. Furthermore, attached to the housing is a base plate carrying a resistive strip engaged by the wiper.

12 Claims, 5 Drawing Sheets

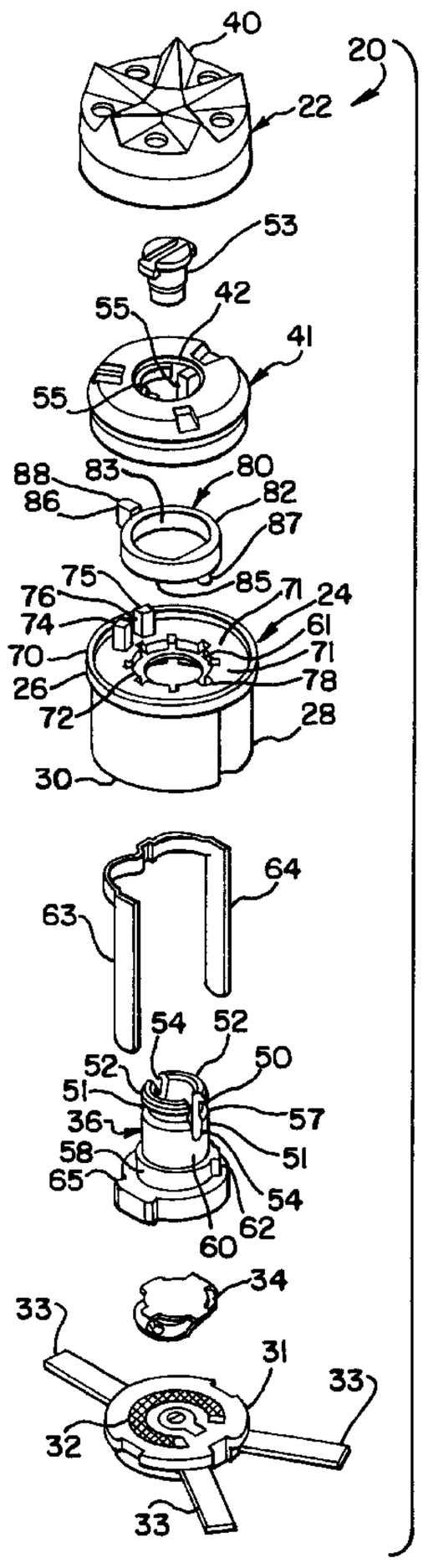

FIG.1

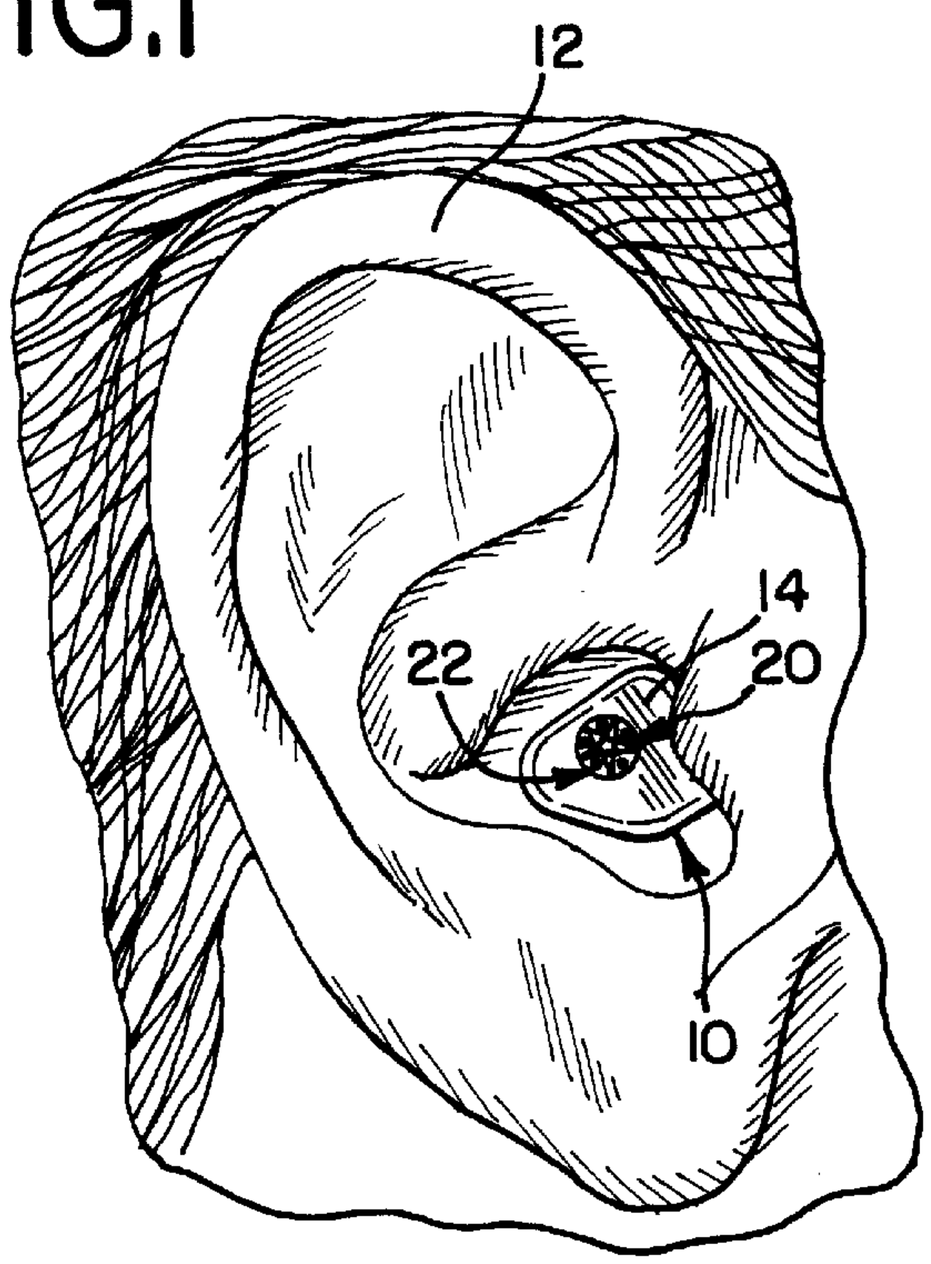

FIG.2

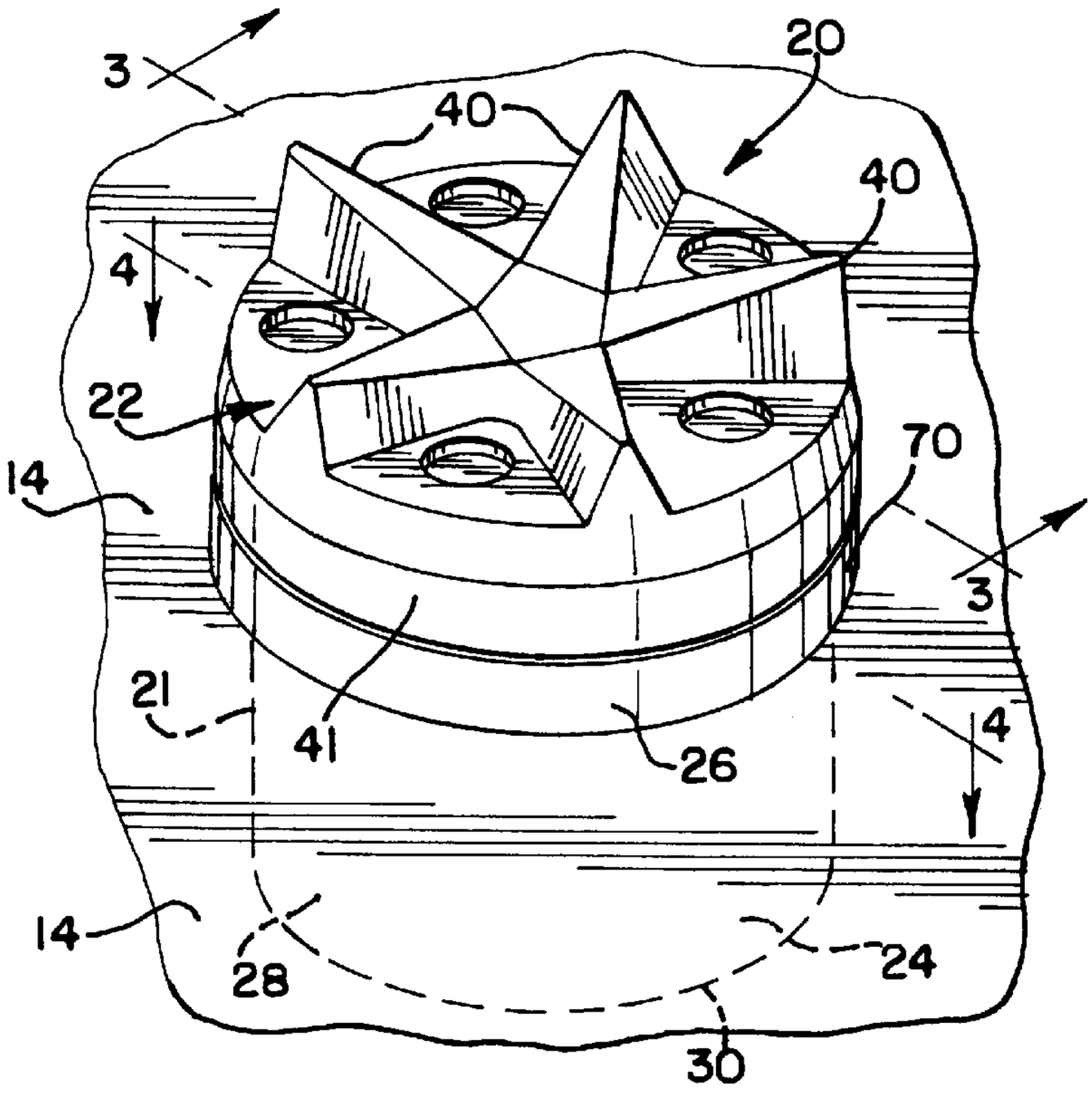

FIG.4

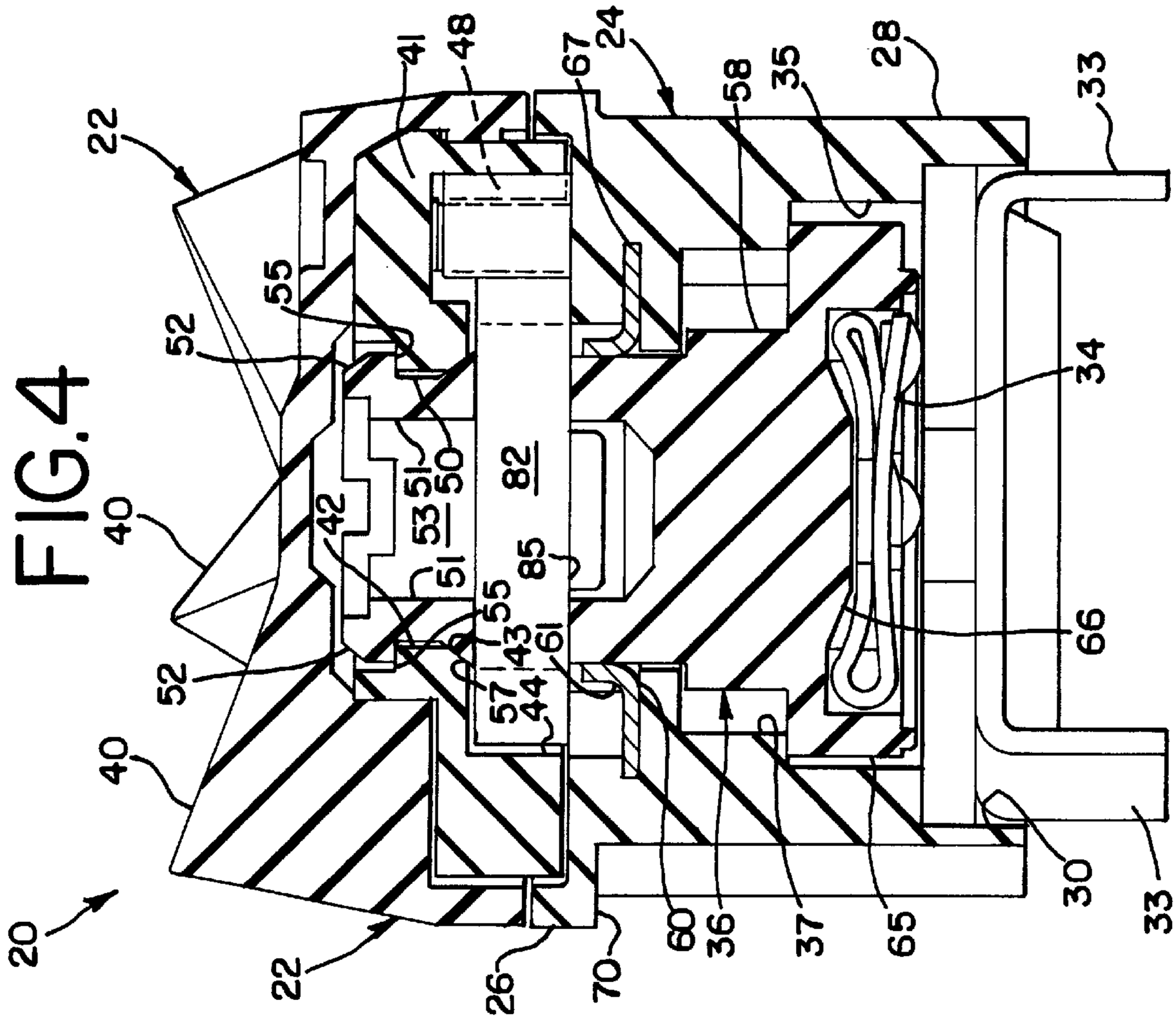
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FIG.3

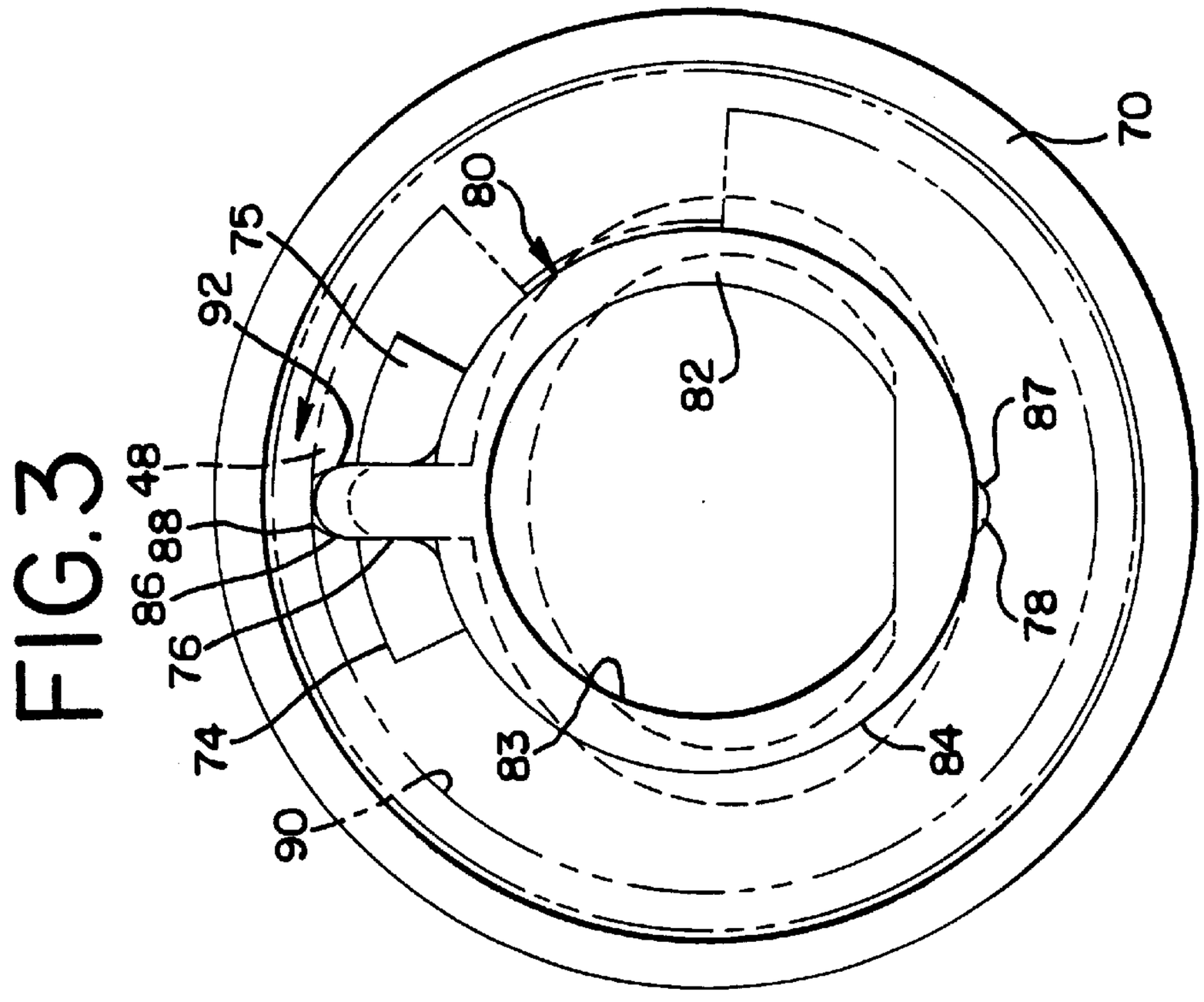
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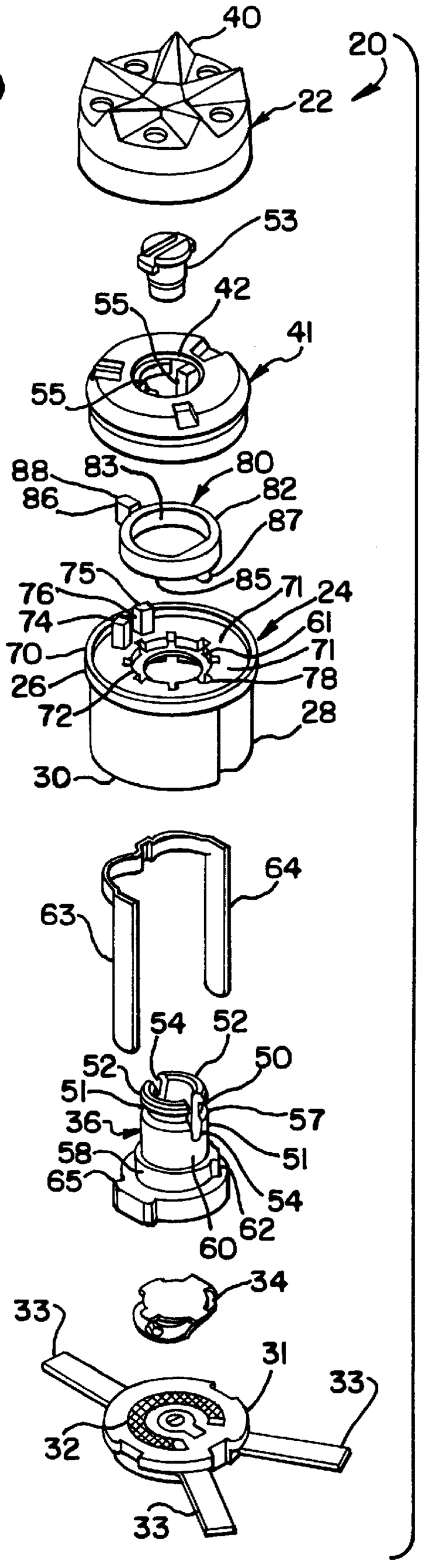
FIG.5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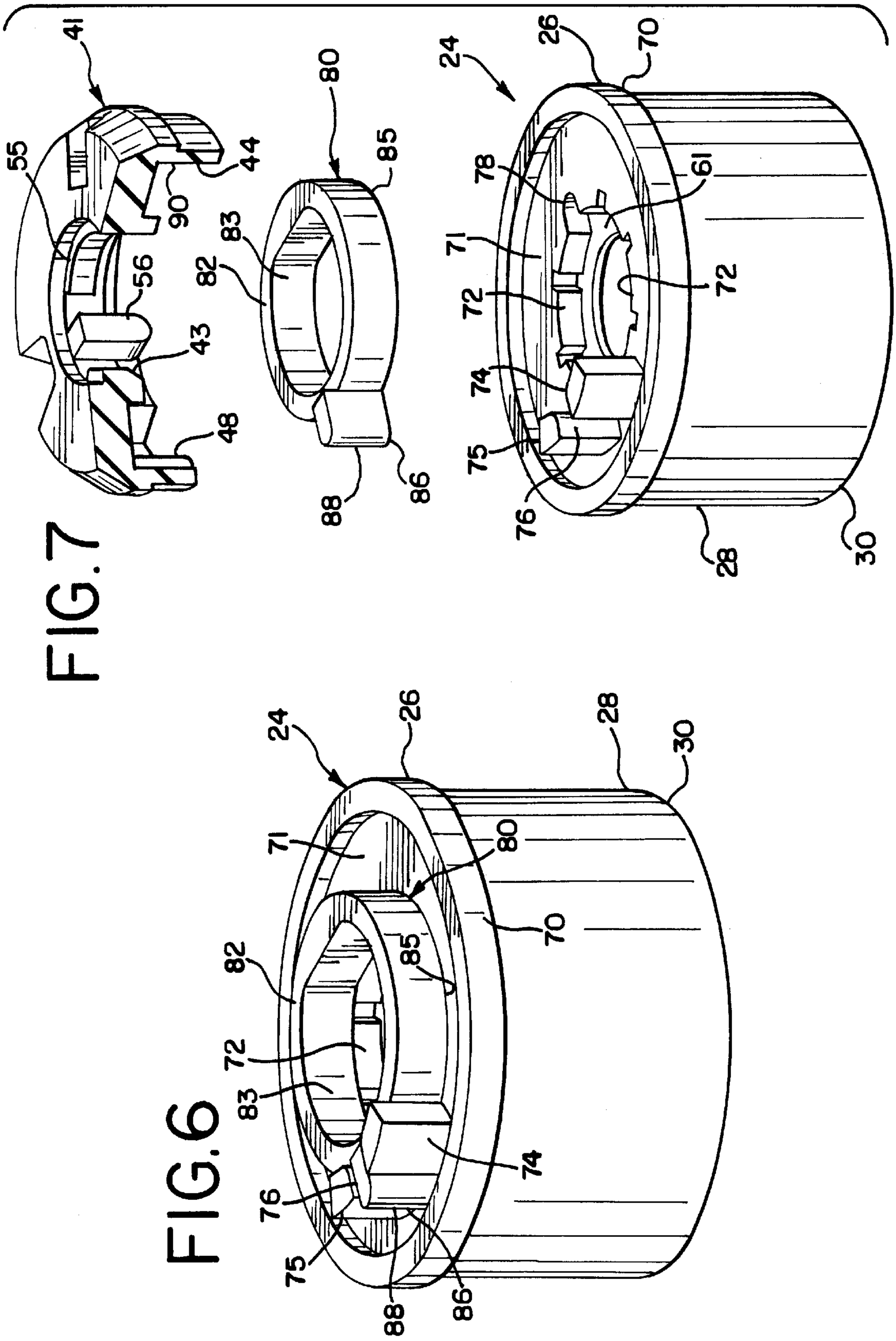
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FIG.7

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FIG.6

FIG.9

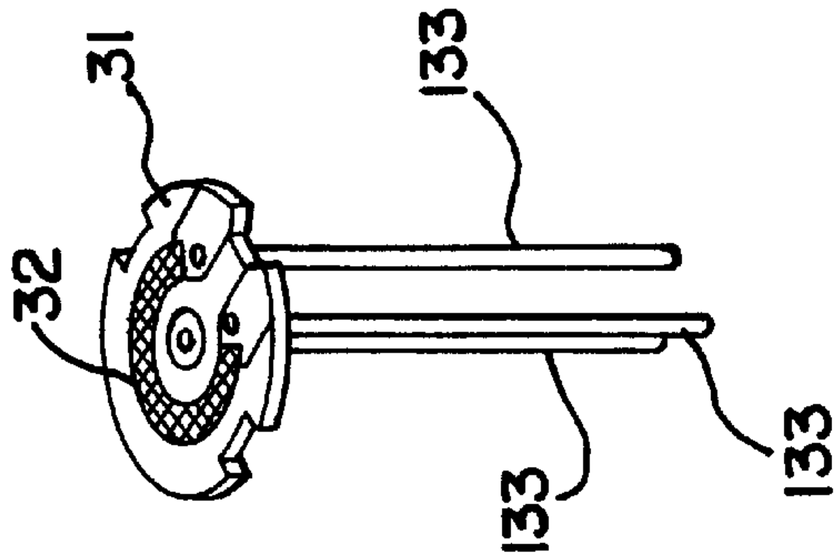
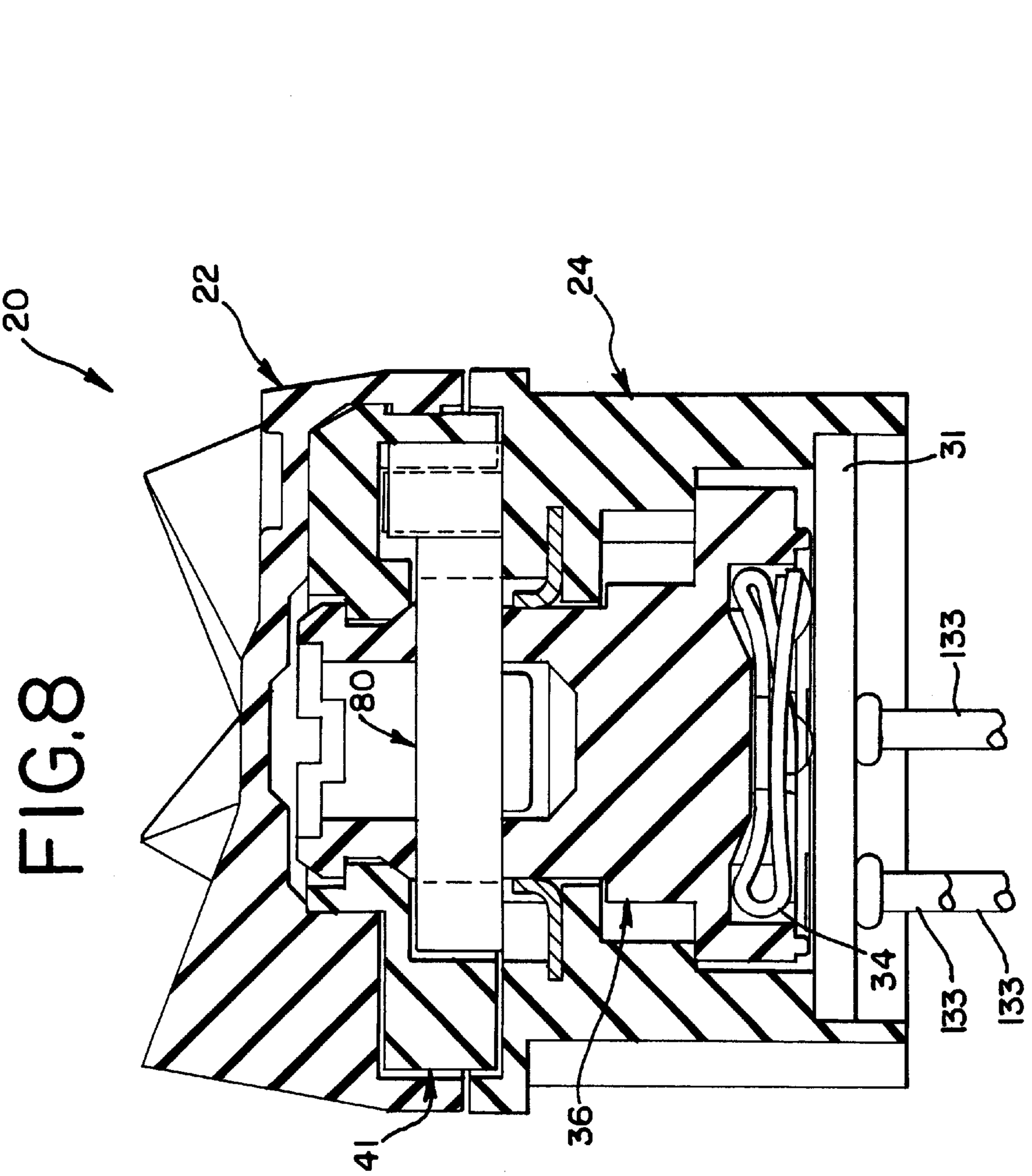


FIG.8



POTENTIOMETER DETENT

TECHNICAL FIELD

The present invention generally relates to an apparatus and a method for providing a user with tactile feel while making adjustments to a potentiometer, and in particular to a potentiometer having a resilient detent for providing the user with positioning feedback.

BACKGROUND OF THE INVENTION

Potentiometers find use in a variety of applications where a variable electrical resistance between input and output terminals is desired. Such uses include volume control, light control, instrumentations control, and the like. Most potentiometers include a housing in which a rotor turns, the rotor including electrical contacts that wipe across a resistive strip of a variable resistor.

To provide tactile feel when turning the potentiometer to positions such as off and on, many potentiometers use a detent. However, the detents used in the prior art fail to provide adequate tactile feel after an extended period of use.

SUMMARY OF THE INVENTION

The present invention is an apparatus and a method that provides a user with tactile feel while making adjustments to a potentiometer. The potentiometer includes a housing having a central bore with a rotor extending therein. A knob having a protrusion is operably connected to the rotor along with a wiper. A detent member having a lobe attachment segment and a fixed segment is operably connected to the housing. The lobe is deflected by the knob protrusion while, simultaneously, the ring is compressed by forcing the lobe attachment segment towards said fixed segment. Furthermore, attached to the housing is a base plate carrying a resistive strip engaged by the wiper.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings forming part of the specification, and in which like numerals are employed to designate like parts throughout the same,

FIG. **1** is a perspective view of an application for a potentiometer in accordance with the present invention wherein the inventive potentiometer is shown in a hearing aid positioned in an ear;

FIG. **2** is a partial perspective view of the hearing aid of FIG. **1** with the portion of the potentiometer within the hearing aid depicted partially in phantom;

FIG. **3** is a partial cross sectional view of the potentiometer of FIG. **1** taken along plane **3**—**3** of FIG. **2** wherein the potentiometer includes a housing having a detent in accordance with the present invention operably attached thereto;

FIG. **4** is a cross sectional view of the potentiometer of FIG. **1** taken along plane **4**—**4** of FIG. **2**;

FIG. **5** is an exploded perspective view of the potentiometer of FIG. **1**;

FIG. **6** is a perspective view of the potentiometer housing and detent of FIG. **3**;

FIG. **7** is a partial exploded perspective view of the potentiometer of FIG. **1**;

FIG. **8** is a cross sectional view of another embodiment of a potentiometer in accordance with the present invention having a punched base; and

FIG. **9** is a perspective view of the punched base removed from the potentiometer of FIG. **8**.

DETAILED DESCRIPTION

While this invention is susceptible of embodiments in many different forms, there is shown in the drawings and will herein be described in detail a preferred embodiment of the invention with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the broad aspect of the invention to the embodiment illustrated.

Referring to FIG. **1**, a potential environment is depicted for a potentiometer in accordance with the present invention. In particular, a hearing aid **10** is shown positioned in a person's ear **12**. The hearing aid **10** comprises a hearing aid body **14** and a potentiometer **20**. Hearing aid body **14** includes a battery and all of the necessary electric and electronic circuitry needed for the hearing aid **10** to function, with the exception of the circuitry needed to perform the function of the potentiometer **20** to be described hereinafter.

Referring now to FIGS. **2**–**7**, an embodiment of the present invention having an improved detent is described. In broad detail, the potentiometer **20** shown in the FIGURES is disposed within a socket **21** in the hearing aid body **14**. Potentiometer **20** includes a rotatable, manipulatable control knob **22** and a generally cylindrical housing **24** having integral top and bottom housing portions **26** and **28**, respectively. Bottom housing portion **28** has an open bottom **30** that receives a baseplate **31**, which in turn holds a resistive strip **32** having electrical contacts **33**. A wiper **34** provides a varying resistive contact with the resistive strip held within the baseplate **32**. Wiper **34** is held in place in part by a rotor **36** contained partially within a housing chamber **37** formed within housing **24**. Rotor **36** in turn is operably attached to knob **22** so that it is jointly rotatable therewith.

Potentiometer **20** functions in a manner similar to known potentiometers in that rotation of knob **22** causes rotor **36** to rotate therewith, thereby moving wiper **34** across the resistive strip **32** contained within base plate **31** so as to vary the resistance between the electrical contacts **33** of the potentiometer. In this well known manner, the user can thus vary the volume of the hearing aid **10**, for example, or the illumination in a lighting system, or other such application. Because the functioning of a potentiometer in this regard is well known in the art, a further explanation will not be provided herein. Further description of a potentiometer, a resistive strip, and how they function to vary the electrical output between the electrical contacts of the potentiometer can be found in many basic electrical device texts or, for example, in U.S. Pat. No. 4,803,458 to Trine et al.

With the foregoing explanation of the intended use of potentiometer **20**, as well as the delineation of several major components thereof, a more detailed description of the potentiometer **20** will now be given. As can be seen in FIG. **4**, in order to allow easy manipulation of the knob **22** of the potentiometer **20**, a tolerance gap **38** is maintained between knob **22** and top housing portion **26**. Knob **22** has a generally circular configuration and includes a plurality of upwardly extending flanges **40**. Flanges **40** aid the user in the rotational manipulation of the knob **22**. Knob **22** is attached to a generally annular base **41** having a central passage **42** in fluid communication with a funnel shaped portion **43**, and a generally annular inner passage **44**. Further, an outer lobe or protrusion **48** is integrally attached to the knob base **41** and extends into annular passage **44**.

Central passage **42** slidingly but snugly receives a stem portion **50** of rotor **36**. The stem **50** includes a pair of semi-cylindrical prongs **51** with the outer ends **52** of the prongs radially projecting outwards. Inserted between the

prongs **51** is a plug **53** for maintaining the prongs in generally spaced parallel relationship to each other with a pair of slits **54** between the prongs. Further, the ends **52** of the prongs **51** engage an annular sill **55** defined within the central passage **42** of the knob base **41**. Thus, the knob base **41** cannot be pulled free of rotor **36**. Further, extending into annular passage **44** and integral with the knob base **41** are a pair of tabs **56** engaged within the slits **54** defined by the rotor prongs **51**. This results in knob **22**, knob base **41**, and rotor **36** being jointly rotatable as a single rotatable structure.

Rotor **36** can be manufactured from a synthetic material such as a thermoplastic material. If desired, it can be fiber reinforced. As noted above, rotor **36** includes a stem **50** that extends outwardly beyond the housing **24**. The prongs **51** of stem **50** define a frustum-like outer surface **57** longitudinally bisected by slits **54**. The outer surface **57** engages funnel shaped portion **43** of the knob base **41**. The stem **50** is attached, preferably integrally, to a column portion **58** of the rotor **36**. Also, the proximal end **59** of stem **50** is substantially cylindrical to form a sealing surface **60** engaged by a sealing element **61**. The sealing element **61** has a substantially annular disk-like configuration with a central aperture for receiving the rotor **38**. As disclosed in U.S. Pat. No. 5,250,926 to McSwiggen, incorporated herein by reference, the sealing element prevents foreign material from entering the housing and interfering with the electrical connection between the wiper **34** and resistor element **32**.

The column portion **58** of rotor **36** has protuberances **62** thereon that engage on/off switch contacts **63**, **64** as knob **22** and thus rotor **36** are rotated. Potentiometer **20** functions in a known manner similar to other potentiometers having rotatable on/off switches and thus will not be described further. Rotor **36** further includes a base **65** having a countersunk portion **66** in which wiper **34** reposes as best seen in FIG. **4**.

As shown in FIG. **4**, housing **24** includes an inner annular groove **67** for receiving the outer circumference edge of sealing element **61**. Turning to FIG. **5**, the top portion **26** of the housing **24** includes an radially outward extending flange **70**. The top portion **26** of the housing **24** also includes a planar annular top surface structure **71** having a centrally disposed passage **72** for receiving the stem **50** of rotor **36**. Upwardly extending from the top planar surface **71** are a pair of walls or guide blocks **74**, **75** having a spacing or gap **76** therebetween. Opposite the gap **76** and formed in the top surface **71** within center passage **72** is a notch **78**.

Preferably, the guide blocks **74**, **75** extending from the housing top surface **71** are received within the annular passage **44** of the knob base **41**. Also contained within the annular passage **44** is a resilient detent member **80** having an endless resilient band or ring **82** with an outer radial surface **84**, a planar bottom surface **85**, and defining a center aperture **83** for receiving the stem **50** of rotor **36**. Perpendicularly extending from a plane tangential to the outer radial surface **84** of band **82** is an inner lobe or detent protrusion **86** received within the gap **76** between walls **74** and **75**. Also, a cylindrical post or locating peg **87** perpendicularly extends from the bottom surface **85** of the ring **82** and is received within the notch **78** in the housing top surface **71**. Accordingly, where the detent protrusion **86** and the locating peg **87** extend from the ring **82** define a lobe attachment segment and a fixed segment of the ring, respectively.

The distal end **88** of the detent protrusion **86** is blunted and projects from between wall **74** and **75**. Typically, the distal end **88** is proximate to the radial surface **90** of the annular passage **44** within the knob base **41**.

In operation, rotation of the knob base **41** by a user in the counterclockwise direction indicated by arrow **92** in FIG. **3**, for example, results in like rotation of knob lobe **48**. As the knob base **41** is rotated, knob lobe **48** comes into contact with detent **86**. As the knob base **41** is further rotated in the counterclockwise direction, additional force is required to rotate the knob **22** as knob lobe **48** slides against and forces the detent **86** away from the radial surface **90** of the annular passage **44** within the knob base **41** as shown in phantom in FIG. **3**. Retraction of detent **86** results in compressed deformation of the resilient band **82** into generally an elliptical shape wherein engaged post **87** maintains the position of the band opposite of detent **86**. Further rotation of the knob base **41** in the counterclockwise direction results in movement of knob lobe **48** away from detent **86**. This results in resilient band **82** being able to regain its generally cylindrical shape while projecting detent **86** towards the radial surface **90** of the annular passage **44** within the knob base **41**. Accordingly, compression and decompression of the band as the knob **22** is rotated between predetermined on and off positions provides the user with a tactile sensation of the on and off positions of the potentiometer and thus the hearing aid **10**.

As will be appreciated by those skilled in the art, the detent member **80** can be fabricated from a different material than the housing **24**. The material used to fabricate the detent member **80** is related to the force necessary to deform the ring **82**. Likewise, the thickness of the ring **82** relates to the amount of force required to deform the ring.

As indicated above, housing member **24** has a generally cylindrical outside configuration. Housing **24** includes a central bore **35** having a stepped internal configuration for receiving rotor **36**. Thus, as shown in the FIGURES, housing bore **35** receives the rotor stem **50**, column **58**, and base **65**.

Turning to FIG. **8**, a cross sectional view is provided of another embodiment of a potentiometer in accordance with the present invention. The potentiometer **120** is similar to that shown in FIGS. **1–7** except that a plurality of electrical conductive pins **133** extend from the punched base **31** instead of beam members extending from a baseplate. Accordingly, the last two digits in the one hundred series of reference numbers in FIGS. **8** and **9** are the same as the reference numbers to like elements depicted in FIGS. **1–7**.

While the specific embodiment has been illustrated and described, numerous modifications come to mind without significantly departing from the spirit of the invention and the scope of protection is only limited by the scope of the accompanying claims.

I claim:

1. An apparatus comprising:

a housing having a central bore;

a rotor extending into said central bore;

a knob operably connected to said rotor and having a protrusion; and,

a detent member having an annular spring and an lobe coupled together, said spring having a free segment and a fixed segment, said lobe radially deflected by said protrusion while said spring is compressed by forcing said free segment and said fixed segment closer together.

2. The apparatus of claim **1** wherein a wiper is operably attached to said rotor and a base plate is attached to said housing and carrying a resistive strip engaged by said wiper.

3. The apparatus of claim **1** wherein said housing includes an annular support surface having a passage and said rotor extends through said passage.

4. The apparatus of claim **3** wherein said annular support surface includes a notch.

5. The apparatus of claim **4** wherein said spring is generally annular and said fixed segment includes a registration pin engaged in said notch.

6. The apparatus of claim **1** wherein said housing includes at least one guide block and said lobe of said detent member slides against said guide block.

7. The apparatus of claim **1** wherein said fixed segment of said spring includes a registration pin engaged in a notch in said housing, and said lobe of said detent member is coupled to said free segment of said spring.

8. A potentiometer comprising:

a housing having a central bore;

a rotor extending within said central bore;

a knob having a base operably connected to said rotor and a protrusion extending from said base;

a detent member having a ring with a lobe extending therefrom, said ring having a lobe attachment segment and a fixed segment operably connected to said housing, said lobe radially deflected by said protrusion while said ring is compressed by forcing said lobe attachment segment towards said fixed segment;

a wiper operably attached to said rotor; and,

a base plate attached to said housing and carrying a resistive strip engaged by said wiper.

9. The potentiometer of claim **8** wherein said housing includes an annular support surface having a passage, said rotor extends through said passage, and said detent member is mounted against said support surface.

10. The potentiometer of claim **9** wherein said annular support surface includes a notch.

11. The potentiometer of claim **10** wherein said fixed segment includes a registration pin engaged in said notch.

12. The potentiometer of claim **8** wherein said housing includes at least one guide block and said lobe of said detent member slides against said guide block.

* * * * *